California Regional Water Quality Control Board
Santa Ana Region

March 15, 2002

Item: 12

Subject: **RESULTS OF ANNUAL WATER QUALITY SAMPLING FOR THE YEAR 2001 – SANTA ANA RIVER BELOW PRADO DAM**

Summary

The Basin Plan specifies water quality objectives applicable to Reach 3 of the Santa Ana River (River). To determine compliance with these objectives, the Basin Plan requires that sampling of the River be conducted annually at Prado Dam during base flow conditions.

Regional Board staff conducted the year 2001 sampling over a five-week period during August and September. The results of the year 2001 sampling program indicate that the River at base flow is meeting Basin Plan objectives for all constituents.

Stream flow at Prado Dam during the sampling period ranged from 186 to 207 cubic feet per second (cfs).

Background

The Santa Ana River is the major source of recharge to the Orange County groundwater basin. The Basin Plan specifies certain water quality objectives applicable to Reach 3 of the River (Mission Blvd. in Riverside to Prado Dam) at base flow. The intent of these objectives is to protect the Santa Ana River quality and its use for groundwater recharge. Compliance with these objectives is verified by annual measurement of the base flow quality. Base flow is composed of wastewater discharges; nonpoint sources discharges (such as agricultural and urban runoff other than stormwater) and rising groundwater. Storm flow is not a component of base flow, therefore, the River is sampled at that time of year (normally August and September) when the influence of storm flow is at a minimum[1].

Methods

The sampling program was carried out weekly from August to September 2001. Each week, an ISCO[2] sequential sampler was deployed to automatically collect a 24-hour composite sample. The composite sample was then sent to Associated Laboratories for mineral analyses, including

[1] In setting the base flow objectives, it was assumed that storm flows that recharge the Orange County groundwater basins would improve the quality of that groundwater. It was also recognized that there could be no assurance that such storm flows would occur each year. Therefore, it was imperative to control base flow quality such that under these worst case conditions (no high quality storm flows), Orange County groundwater quality would remain protected.

[2] Mention of trade names does not imply endorsement of these products.

total dissolved solids (TDS), chloride, sulfate, sodium, boron, hardness and electrical conductivity (EC). In addition, three grab samples were collected during the 24-hour period and analyzed for nutrients, chemical oxygen demand (COD) and total organic carbon (TOC). Associated Laboratories, the Regional Board's contract laboratory, performed all chemical analyses.

Water temperature, dissolved oxygen, pH and EC were measured in the field using a YSI[2] multi-parameter probe each time a grab sample was collected. These measurements were made with calibrated field equipment. Stream flow measurements were obtained from the US. Geological Survey after the sampling program was completed.

Orange County Water District (OCWD) also conducts an independent water quality-monitoring program in the Santa Ana River below Prado Dam. Board staff used OCWD's data to compare and confirm the Prado Dam results.

Results and Discussion

2001

The year 2001 Prado Dam sample results for the mineral constituents (TDS, hardness, sodium, chloride, boron, sulfate and EC) are shown in Table 1. Five separate composite samples were collected during the base flow period. All mineral parameters were below the respective Basin Plan objective.

The field and grab sample data for total nitrogen, COD and TOC are shown in Table 2. Total nitrogen concentrations ranged from 5.10 to 7.9 mg/L, with an average concentration of 6.08 mg/L. All total nitrogen concentrations were below the Basin Plan objective.

COD concentrations ranged from 10 to 20 mg/L, with an average of 14 mg/L. None of the COD measurements exceeded the Basin Plan objective of 30 mg/L.

TOC is a direct measurement of the organic content in water. TOC was added to the annual sampling program in 1989 because the California Department of Health Services (DHS) has proposed specific TOC removal concentrations when reclaimed water is used to recharge groundwater. DHS has not finalized the groundwater recharge regulations; however, the latest draft provides TOC guidelines for the Santa Ana River recharge activities. When 46 – 50% reclaimed water is used in surface spreading, the draft regulations specify a maximum allowable TOC of 6 mg/L. Once the guidelines become regulations, it is anticipated that a TOC objective may be recommended for incorporation into the Basin Plan. The 2001 TOC concentrations in the River ranged from 4.0 to 9.4 mg/L with an average concentration of 5.10 mg/L. One TOC measurement of 9.4 mg/l (September 6, 2001) exceeded the recommended DHS guideline of 6 mg/l. The rest of the TOC results are well below the DHS guidelines.

OCWD sample results at Prado Dam for TDS and total nitrogen are shown in Table 3. TDS concentrations ranged from 560 to 620 mg/L and averaged 592 mg/L; total nitrogen concentrations ranged from 5.02 to 6.09 and averaged 5.67 mg/L. OCWD analyzes once a year

for COD. The 2001 result for COD was 9 mg/l. These results are consistent with the Regional Board's results from Prado Dam.

1983-2001

Table 4 summarizes the yearly averages of various constituents along with their respective water quality objectives over time for the Prado Dam sampling program. The data indicate that the water quality of Reach 3 of the Santa Ana River for these parameters continues to improve; most concentrations are below the objectives specified in the Basin Plan.

The graphs for the 1983 – 2001 data on Table 4 are found in Figures 1 through 9. Figure 9 in particular, depicts total nitrogen concentrations from 1983 to 2001. In recent years (1998-2000), total nitrogen concentrations have been consistently below the Basin Plan objective. The 2001 results for total nitrogen continue with that same trend. This may be due to a number of factors including improvements in the wastewater nitrogen discharges as result of the Regional Board nitrogen control strategies. In addition, both OCWD and the City of Riverside operate wetland treatment facilities that serve to reduce nitrogen levels in the River and in the City's wastewater effluent.

TDS concentrations over time are shown in Figure 7. TDS concentrations continue to decrease from the elevated concentrations measured in the early 1980s, again likely due to a number of factors including wastewater treatment improvements or water supply improvements.

Conclusion

The results of the 2001 Prado Dam sampling program indicate overall compliance with the Basin Plan objectives. Unlike previous years, COD concentrations in 2001 were below the objective.

TABLE 1
Santa Ana River below Prado Dam
Year 2001 Mineral Analyses

Date	Discharge (cfs)	Conductivity (umhos/cm)	TDS (mg/L)	Total Hardness (mg/L)	Sodium (mg/L)	Chloride (mg/L)	Sulfate (mg/L)	Boron (mg/L)
8/24/01	186	938	639	250	96.3	106	95	0.344
8/31/01	188	980	637	289	95.6	108	100	0.316
9/7/01	182	1001	643	283	103	111	102	0.352
9/14/01	198	958	623	308	97.2	112	101	0.356
9/21/01	207	904	600	251	91.5	110	100	0.302
9/28/01	191	1000	644	N/A	N/A	N/A	N/A	N/A
Average	**192**	**963**	**631**	**276**	**96.7**	**109**	**99**	**0.334**
Basin Plan Obj.	-	-	700	350	110	140	150	0.75

* Value equals or exceeds Basin Plan Objectives

TABLE 2
Santa Ana River below Prado Dam
Year 2001 Nutrient Analyses

Date	Time	Water Temp. (deg. C)	pH	Total Nitrogen (mg/L)	Electrical Conductivity (umhos/cm)	Dissolved Oxygen (mg/L)	COD (mg/L)	TOC (mg/L)
8/23/01	12:30	24.33	7.940	6.29	978	8.59	17	5.0
8/23/01	2:10	23.20	7.970	5.80	978	8.92	20	5.1
8/24/01	12:20	22.40	7.790	N/A	938	8.51	18	5.1
8/30/01	9:40	22.25	7.830	5.90	972	8.68	13	4.9
8/30/01	10:30	23.64	7.900	5.60	980	8.32	13	N/A
8/31/01	10:40	21.82	7.900	N/A	980	8.80	10	6.1
9/6/01	10:40	22.63	7.940	6.70	994	7.88	17	9.4
9/6/01	3:10	25.00	7.810	6.10	983	8.21	16	5.6
9/13/01	11:00	21.02	7.950	6.60	977	9.45	13	4.0
9/13/01	1:40	22.92	8.050	5.80	981	9.47	16	4.2
9/14/01	4:05	24.66	8.100	5.80	958	9.12	13	4.0
9/20/01	11:02	20.94	7.890	6.60	981	9.43	12	4.9
9/20/01	1:20	22.26	8.040	6.50	983	9.34	11	4.6
9/21/01	10:00	20.25	7.960	7.90	974	9.52	12	N/A
9/27/01	10:30	21.64	8.020	5.20	978	10.02	16	4.6
9/27/01	12:00	22.40	7.950	5.10	981	10.48	14	4.9
9/28/01	11:15	21.32	7.480	5.30	1000	8.44	18	4.6
Average	-	22.51	7.910	6.08	977	9.01	14	5.1
Basin Plan Obj.	**-**	**-**	**6.5-8.5**	**10**	**-**	**No less than 5**	**30**	**-**

* N/A = not analyzed
** Value equals or exceeds Basin Plan Objective

TABLE 3
Orange County Water District's Year 2001 Monitoring Results

Date	Station Name	Dissloved Oxygen (mg/L)	EC (umho/cm)	PH (units)	Temp. (deg C)	Ammonia Nitrogen (mg/L)	Nitrate Nitrogen (mg/L)	Nitrite Nitrogen (mg/L)	Boron (mg/L)	TOC@ (mg/L)	Chloride (mg/L)
8/6/01	SAR-BELOWDAM-01	7.58	999	8.3	24.000	0.05*	1.56	0.002	0.4	5.20	114
8/13/01	SAR-BELOWDAM-01	8.00	986	8.4	18.600	0.05*	4.99	0.052	0.4	5.31	107
8/14/01	SAR-BELOWDAM-01	NA	970	NA	22.000	0.05*	3.55	0.091	NA	NA	NA
8/15/01	SAR-BELOWDAM-01	NA	980	7.9	22.000	0.05*	4.72	0.046	NA	NA	NA
8/16/01	SAR-BELOWDAM-01	NA	979	7.9	21.900	0.05*	4.66	0.060	NA	NA	NA
8/17/01	SAR-BELOWDAM-01	NA	970	7.9	22.400	0.05*	4.78	0.095	NA	NA	NA
8/30/01	SAR-BELOWDAM-01	7.70	977	8.3	22.000	0.3	5.14	0.072	NA	5.14	117
9/6/01	SAR-BELOWDAM-01	7.00	1030	8.2	22.600	0.9	4.46	0.116	NA	9.09	111
9/10/01	SAR-BELOWDAM-01	6.20	1010	8.2	20.800	0.05*	5.15	0.062	NA	5.05	111
9/13/01	SAR-BELOWDAM-01	8.40	967	8.3	20.300	0.05*	5.13	0.070	NA	5.13	109
9/20/01	SAR-BELOWDAM-01	8.10	989	8.2	20.500	0.05*	5.00	0.075	NA	4.87	115
9/27/01	SAR-BELOWDAM-01	8.10	961	560	21.200	0.05*	5.10	0.061	NA	5.12	113

* - value is one-half of the reported detection limit
@ - value is for unfiltered sample

TABLE 4
Santa Ana River Base Flow Results for 1983 – 2001 Averages

Year	Discharge (cfs)	TDS (mg/L)	Total Hardness (mg/L)	Sodium (mg/L)	Chloride (mg/L)	Sulfate (mg/L)	Boron (mg/L)	Total Nitrogen (mg/L)	COD (mg/L)	TOC (mg/L)
1983	213	716*	356*	91	85	NA	0.30	8.2	86*	NA
1984	128	683	350*	96	116	159*	0.40	7.3	58*	NA
1985	138	682	339	96	115	150*	0.33	9.8	33*	NA
1986	123	656	290	98	110	127	0.25	10.2*	43*	NA
1987	132	641	323	97	97	134	0.45	10.2*	27	NA
1988	134	629	297	102	111	130	0.25	10.3*	38*	NA
1989	127	635	290	102	115	128	0.30	10.2*	31*	9.9
1990	131	640	289	107	117	128	0.36	11.9*	26	9
1991	124	648	281	89	101	114	0.36	10.9*	18	5.3
1992	136	617	282	98	110	108	0.36	10.6*	18	4.9
1993	130	672	288	99	125	128	NA	8.2	30*	NA
1994	119	629	286	101	114	140	0.38	8.6	40*	5.5
1995	141	636	276	91	103	104	0.28	7.5	27	4.8
1996	168	578	250	88	97	106	0.27	9.5	22	5.4
1997	149+	607+	218+	89+	99+	112+	0.36+	6.3+	NA	9.7+
1998	245	524	264	85	96	100	0.30	7.4	30@	4.7
1999	190	586	271	99.5	101	110	0.341	6.3	30*	4.8
2000	186	562	251	105	107	105	0.321	6.7	15.47	4.7
2001	192	631	276	96.7	109	99	0.334	6.08	14	5.1
Basin Plan Objective		**700**	**350**	**110**	**140**	**150**	**0.75**	**10**	**30**	**-**

* Value equals or exceeds Basin Plan Objective
N/A Not analyzed
+ 1997 Calculated results
@ value is for unfiltered sample not to be compared with COD Basin Plan Objective

Figure 1 - Boron

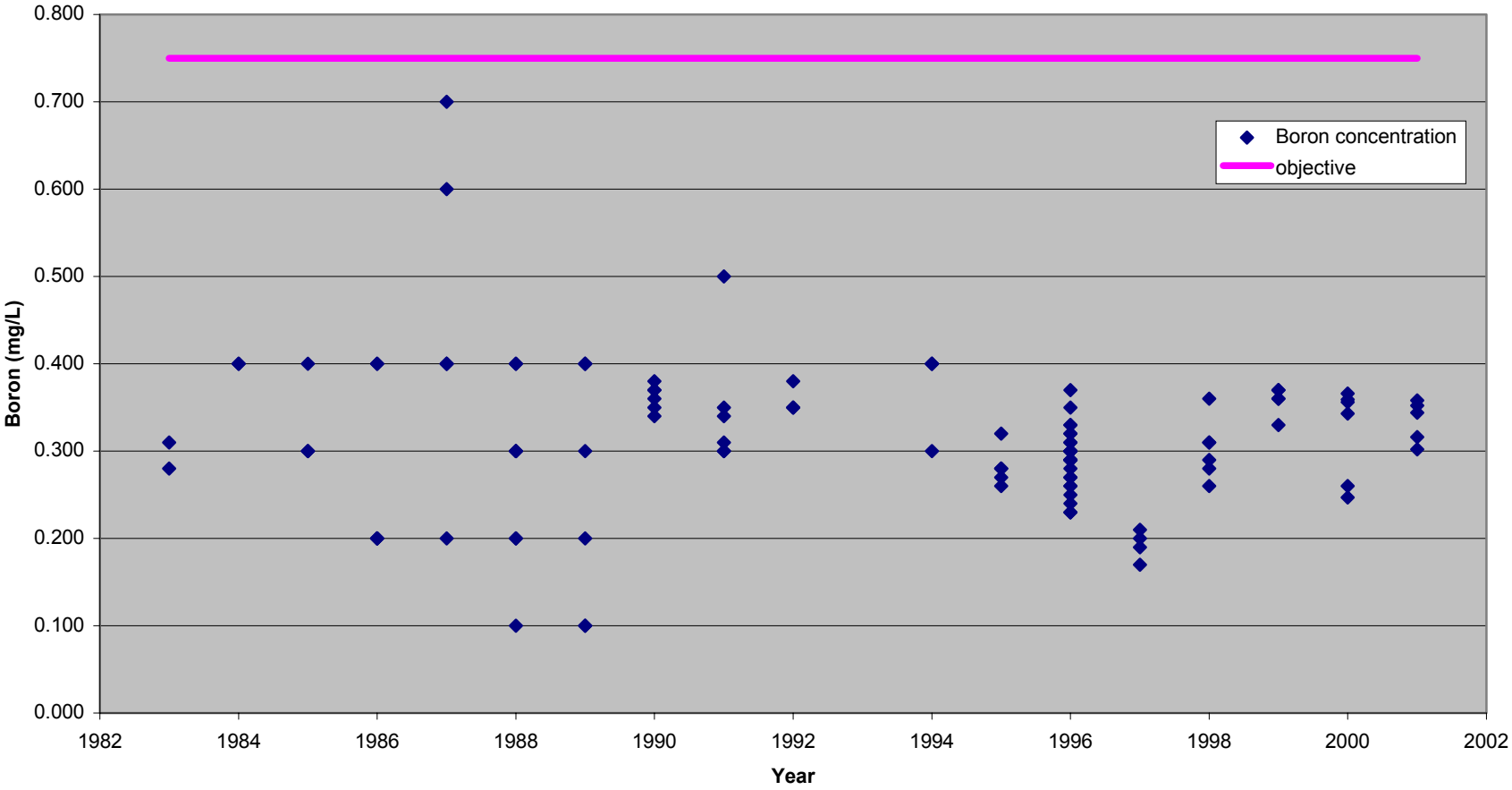

Figure 2 - Chloride

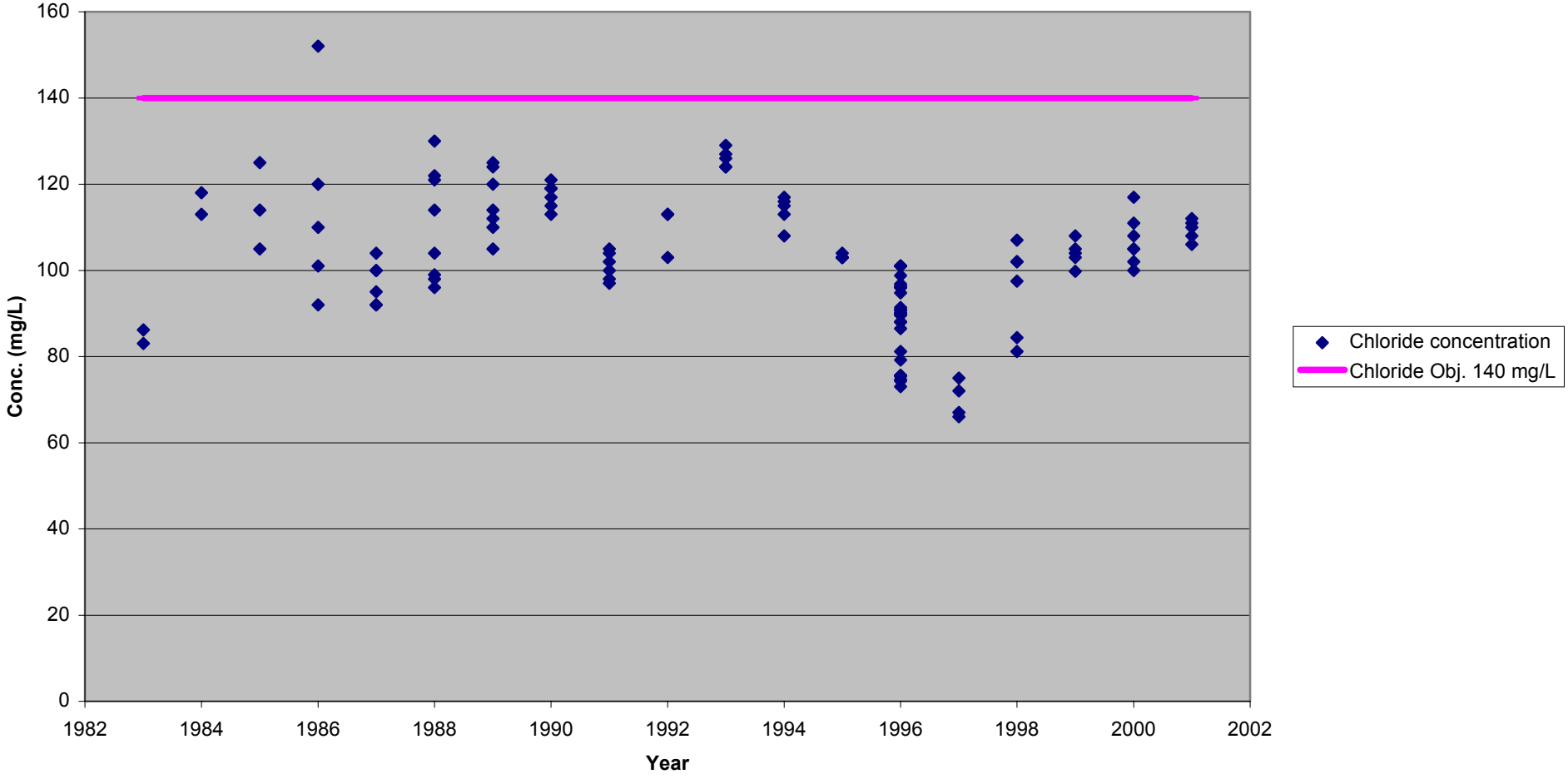

Figure 3 - Chemical Oxygen Demand

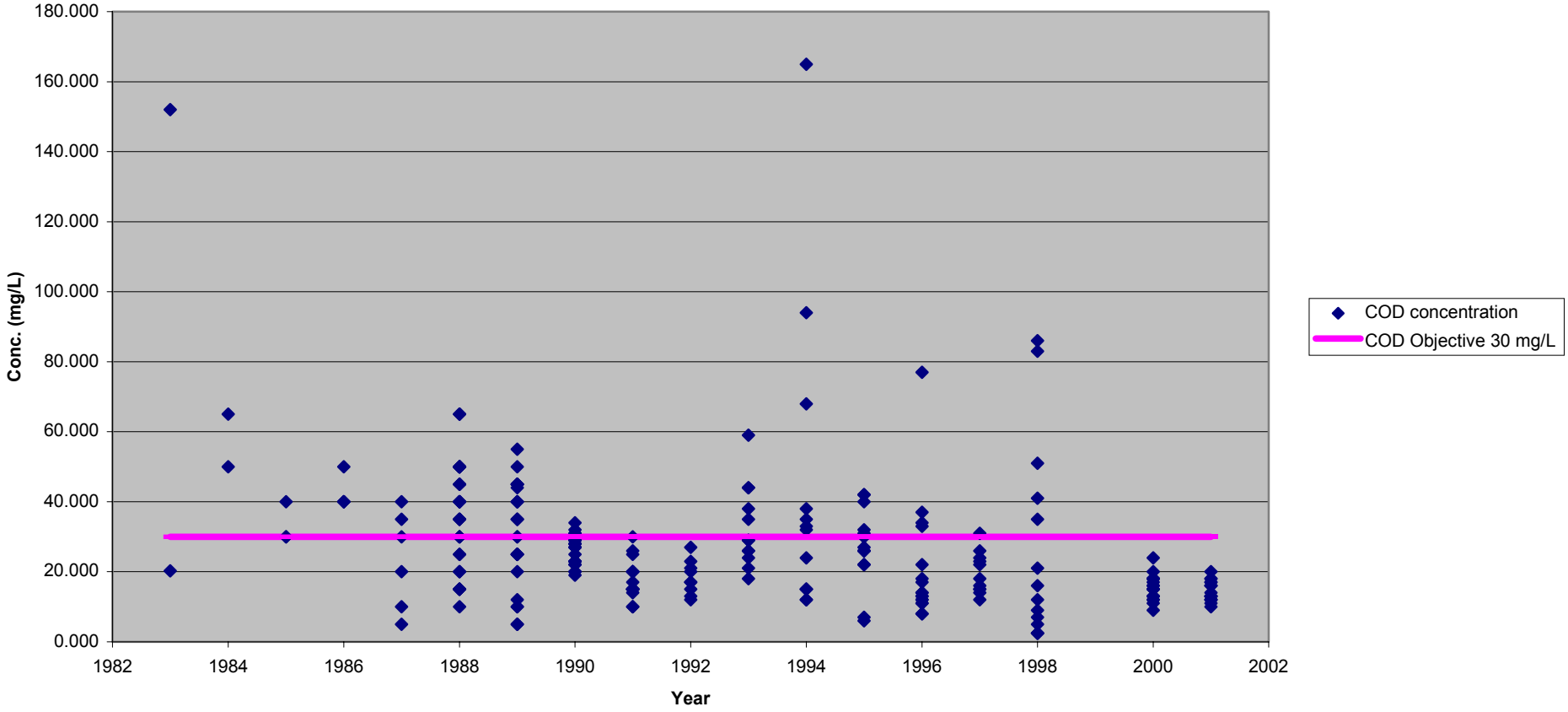

Figure 4 - Total Hardness

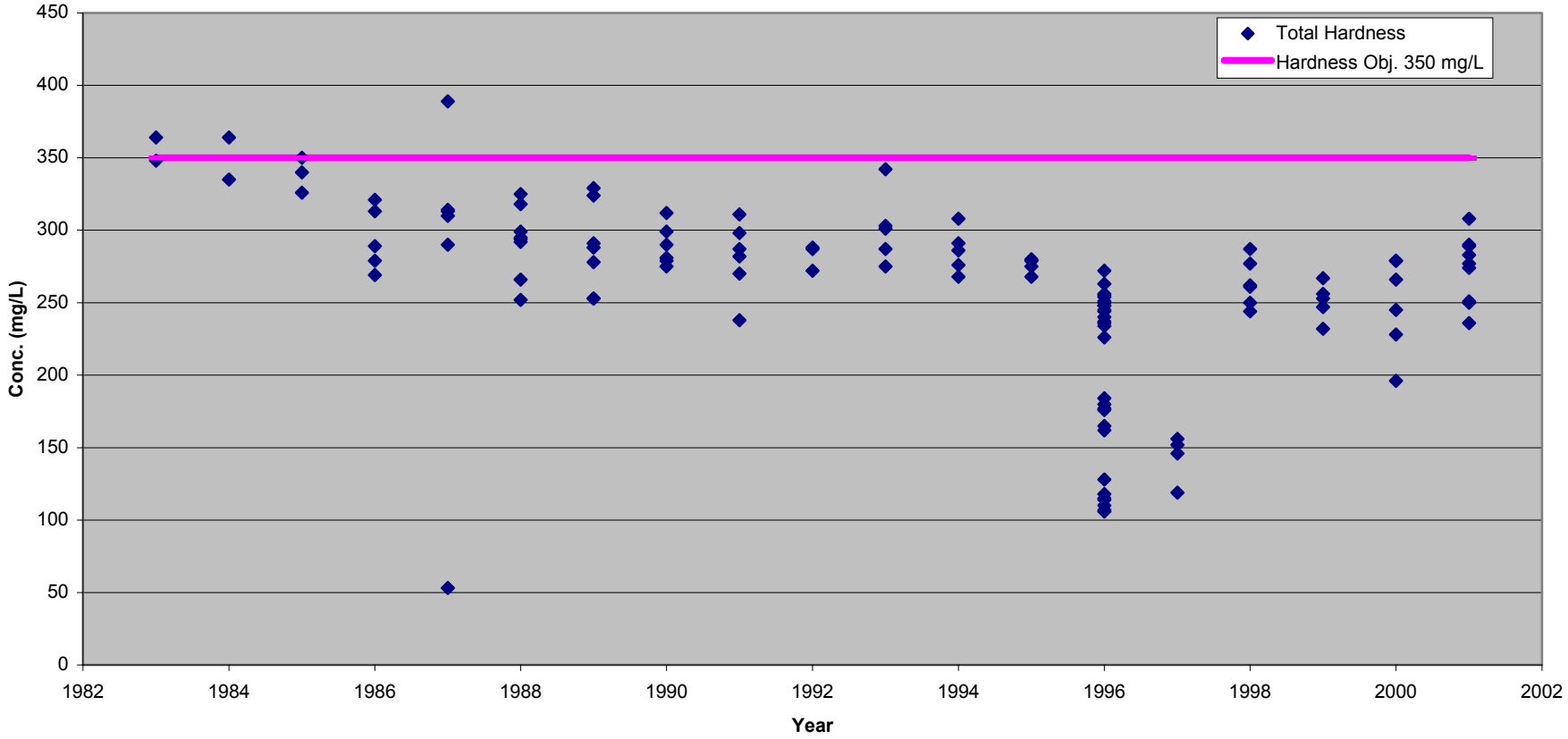

Figure 5 - Sodium

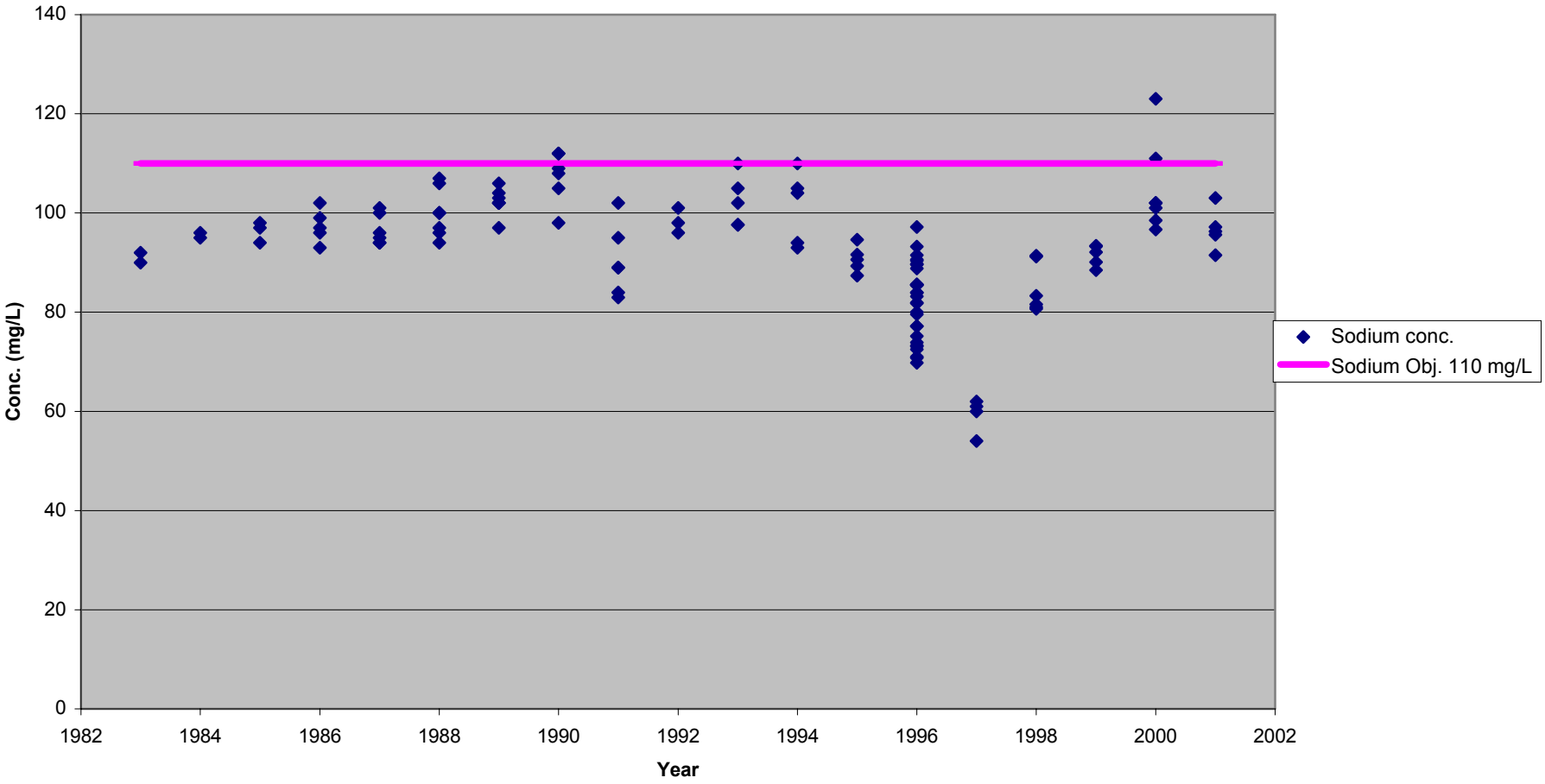

Figure 6 - Sulfate

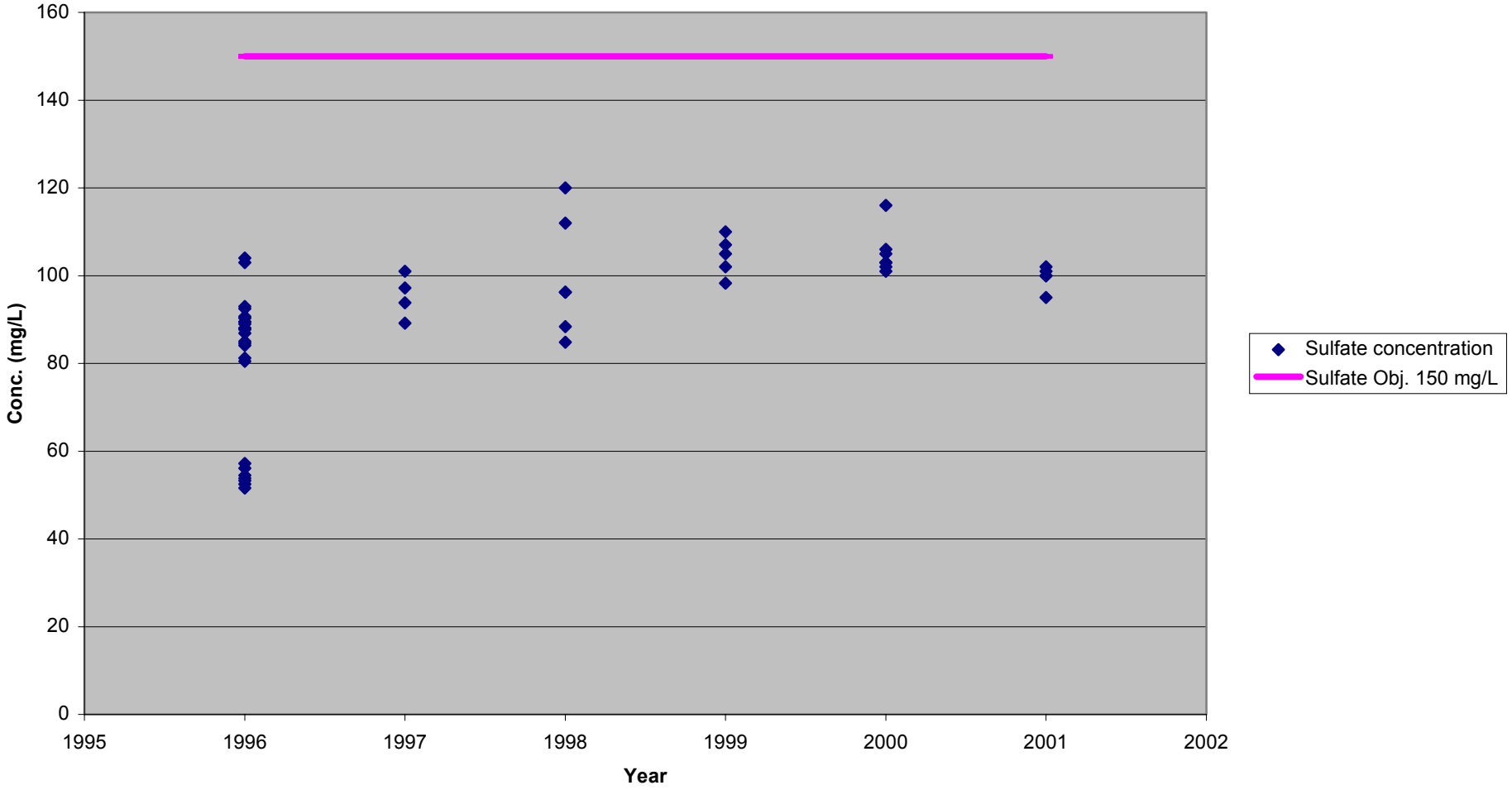

Figure 7 - Total Dissolved Solids

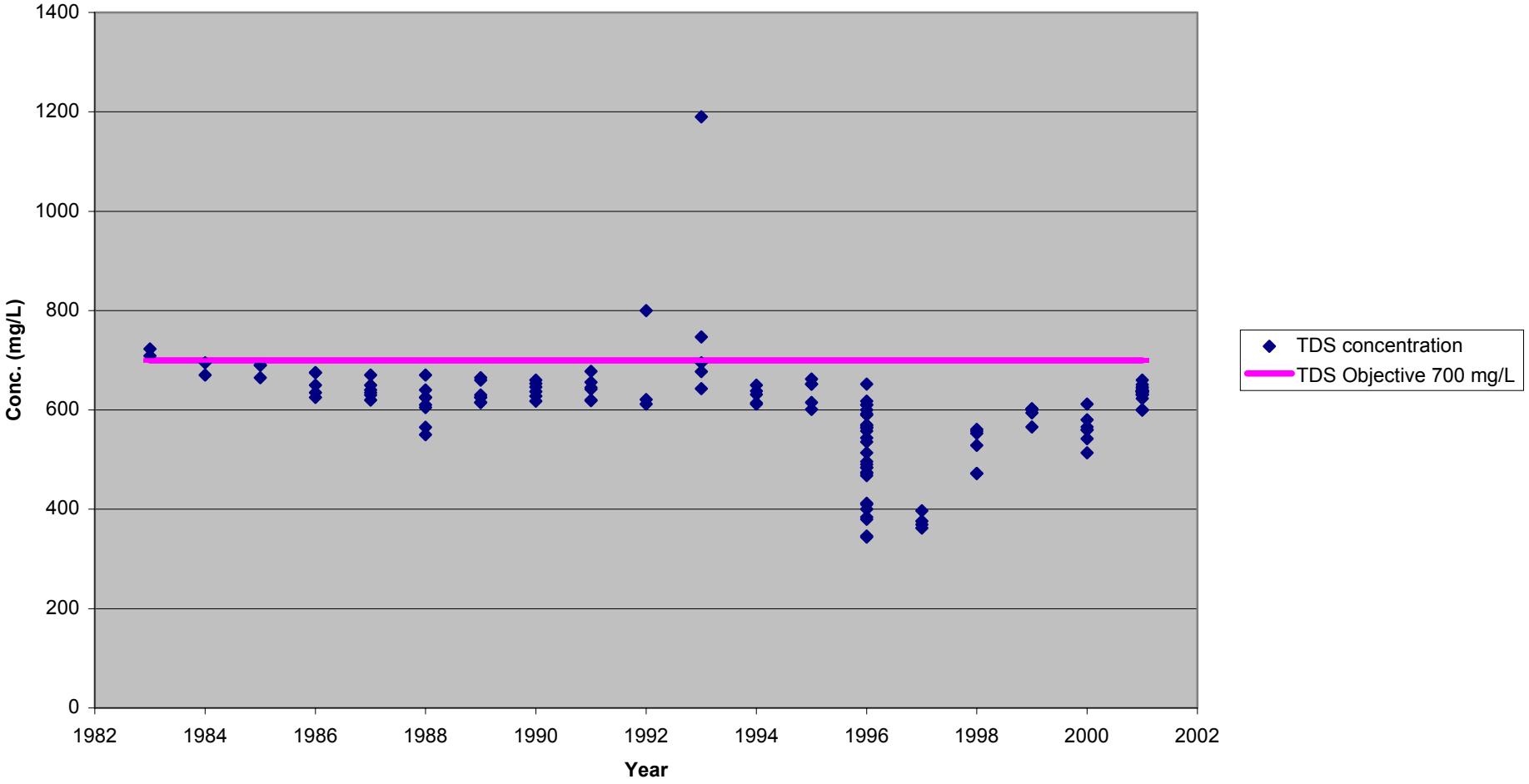

Figure 8 - Total Organic Carbon

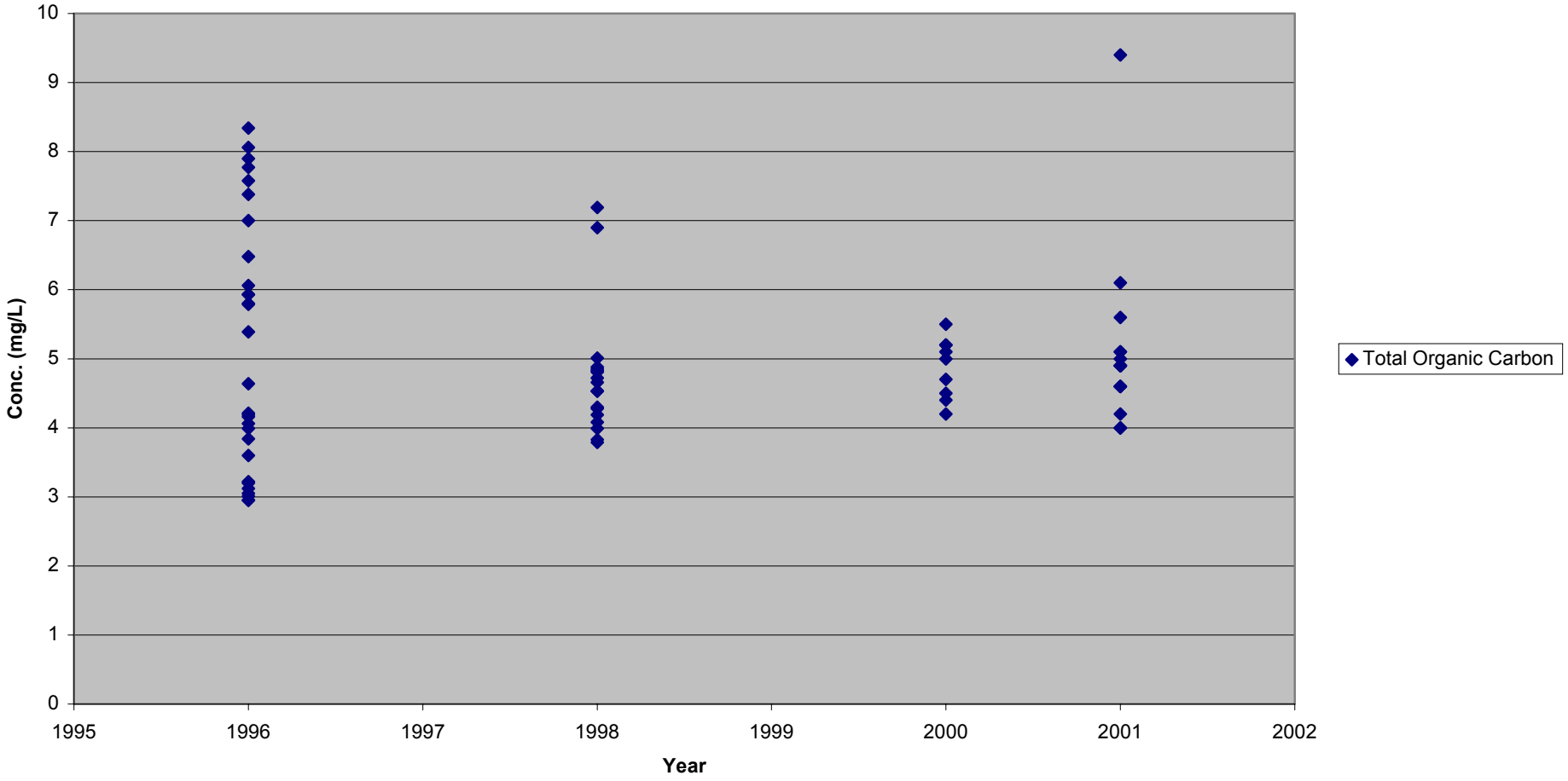

Figure 9 - Total Nitrogen